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FEMA 209.CH0125.987

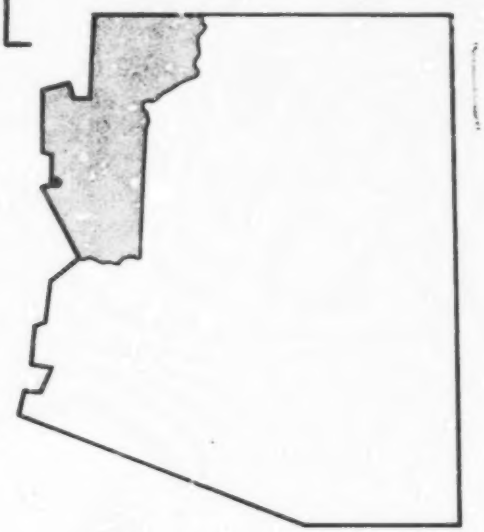
FLOOD INSURANCE STUDY

COMPLETED 34

ORIGINAL

CITY OF BULLHEAD CITY, ARIZONA

MOHAVE COUNTY



REVISED: SEPTEMBER 4, 1987

Federal Emergency Management Agency

COMMUNITY NUMBER - 040125

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NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

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Flood Insurance Rate Map

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FLOOD INSURANCE STUDY
CITY OF BULLHEAD CITY, MOHAVE COUNTY, ARIZONA

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in Bullhead City, Mohave County, Arizona and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates and assist the community in its efforts to promote sound floodplain management. Minimum floodplain management requirements for participation in the National Flood Insurance Program (NFIP) are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

This Flood Insurance Study revises and updates a previous Flood Insurance Study/Flood Insurance Rate Map for the City of Bullhead City, Mohave County, Arizona, dated August 5, 1986. This information will be used by the City of Bullhead City to update existing floodplain regulations as part of the Regular Phase of the NFIP. The information will also be used by local and regional planners to further promote sound land use and floodplain development.

In some states or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the State (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for the original study were performed by Henningson, Durham and Richardson, Inc., of Arizona, as reported in the Flood Insurance Study for the unincorporated areas of Mohave County, Arizona (Reference 1).

The hydrologic and hydraulic analyses for the revised study on the Colorado River were performed by PRC Engineering Inc. of Phoenix, Arizona, for the Federal Emergency Management Agency (FEMA), under Contract No. EMW-83-C1193. The restudy was completed in March 1986.

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1.3 Coordination

On April 11, 1985, FEMA initiated an existing data study for the City of Bullhead City using data from the Mohave County Flood Insurance Study (Reference 1).

A study of flooding from the Colorado River was initiated at a meeting attended by representatives of Bullhead City, Mohave County, State of Arizona, FEMA and PRC in Boulder City, Nevada on May 19, 1983. Results of the hydrologic analyses were coordinated with the State of Arizona and the U.S. Bureau of Reclamation (USBR).

On February 20, 1986, the results of the study were reviewed at the final meeting attended by representatives of the community, FEMA, and the study contractor (PRC). The study was acceptable to the community.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated areas of the City of Bullhead City, Mohave County, Arizona. The area of study is shown on the Vicinity Map (Figure 1).

The Colorado River was studied by detailed methods from 2.3 miles downstream of Davis Dam to the northern boundary of the Fort Mohave Indian Reservation. The following flooding sources in the North Mohave Valley area (from Katherine Landing to Big Bend) were studied by detailed methods:

Davis Wash, for approximately 2.1 miles upstream of its confluence with the Colorado River.

Highland-Williams Wash, for approximately 4.4 miles upstream of its confluence with the Colorado River.

Highland-Green Wash, for approximately 4.1 miles upstream of its confluence with the Colorado River.

Thumb Butte Wash, for approximately 3.0 miles upstream of its confluence with the Colorado River.

Buck Wash, for approximately 2.2 miles upstream of its confluence with the Colorado River.

Black Wash, for approximately 2.3 miles upstream of its confluence with the Colorado River.

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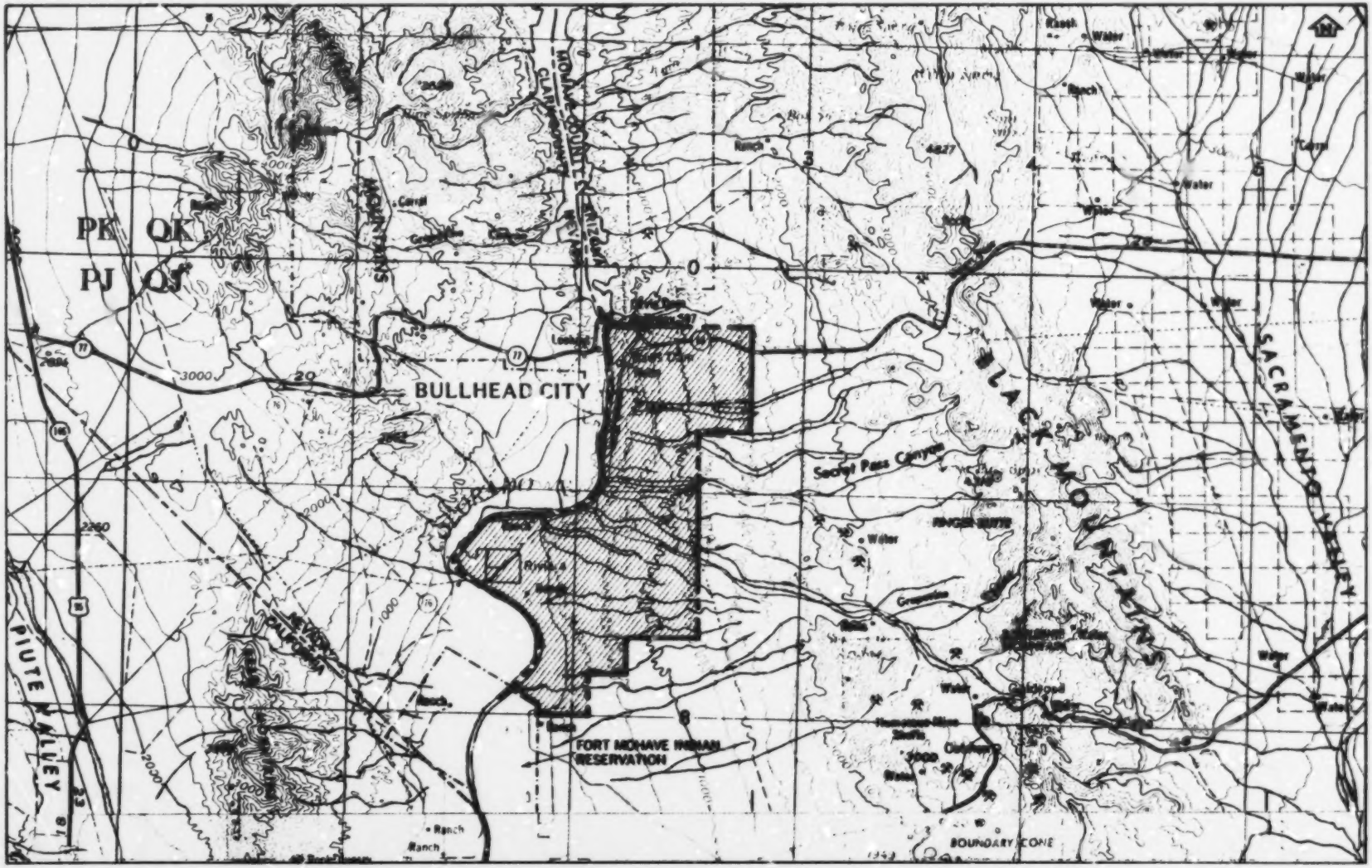

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF BULLHEAD CITY, AZ
(MOHAVE CO.)

APPROXIMATE SCALE

4 0 4 8 12 MILES

VICINITY MAP

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Bullhead Wash, for approximately 1.2 miles upstream of its confluence with the Colorado River.

Secret Pass Wash, for approximately 2.1 miles upstream of its confluence with the Colorado River.

Dump Wash, for approximately 1.3 miles upstream of its confluence with the Colorado River.

Silver Creek Wash, for approximately 3.4 miles upstream of its confluence with the Colorado River.

Montana Wash, for approximately 3.7 miles upstream of its confluence with the Colorado River.

Big Montana Wash, for approximately 3.3 miles upstream of its confluence with the Colorado River.

Chapparal Wash, from its confluence with Bojorquez Wash to State Highway 95.

Bojorquez-Fox Wash, for approximately 2.8 miles upstream of its confluence with the Colorado River.

Soto Wash, for approximately 2.3 miles upstream of its confluence with the Colorado River.

Fort Mohave Wash, for approximately 2.7 miles upstream of its confluence with the Colorado River.

The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development or proposed construction through January 1992.

Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon by, FEMA and the City of Bullhead City.

2.2 Community Description

The City of Bullhead City lies in the North Mohave Valley, along the Colorado River, in west-central Mohave County, in northwestern Arizona. The climate in this area is extremely arid, and the mean annual maximum temperature is 85.4°F. The recorded extreme temperatures are 121°F and 20°F. The mean annual precipitation is 4.2 inches along the Colorado River and is an estimated 8 inches in the Black Mountains (Reference 2).

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Elevations through the Bullhead City area range from 500 to 540 feet. To the east, the Black Mountain Range rises to an elevation of 5,062 feet at Mount Nutt.

Extremely gravelly Carrizo soil makes up the recent alluvial fans originating in the mountains. These fans have been channelized in the northern valley by hills with a Pinamt-Gunsight soil complex. An aerial view of Bullhead City is shown in Figure 2. Potential scouring depths are in excess of 5 feet. The average slope in the northern valley is over 4 percent; in the southern valley, it is approximately 3 percent.

The natural vegetation along the Colorado River includes mesquite, tamarisk, arroweed, and saltgrass. The desert grasses include galleta and three-awns along with other annuals. Creosote bush, bursage, paloverde, and catclaw comprise the desert shrubs. In the foothills, such cacti as cholla, ocotillo, saguaro, and prickly pear are common (Reference 3).

Residential and commercial development has been extensive at the lower elevations in the alluvial fans and along the Colorado River. Commercial development primarily occurs along Highway 95 within the City of Bullhead City, with a few hotel complexes located upon the banks of the Colorado River. Most of the development which is present along the banks of the Colorado River is residential, consisting of recreational vehicle lots, mobile homes, and single family homes. Residents are attracted to the area by the aesthetic and recreational amenities offered by living adjacent to the river. Within the last several years, areas adjacent to the Colorado River have experienced a significant increase in residential development.

2.3 Principal Flood Problems

For the Bullhead City area, the independent alluvial fan washes originating in the higher elevations of the Black Mountains and mesas are the most hazardous source of flooding. Floodwaters are not the only cause of destruction. Scour, erosion, and alluvium deposition have caused catastrophic damage since the development of this area.

The many levees and dikes found in the washes offer no flood protection. Consisting of extremely gravelly sand with no reinforcement or bonding material, these dikes and levees are highly vulnerable to erosion and are easily washed away at any location. Consequently, they provide little or no protection against major flooding.

Historically, major floods occur in July, August, and September, when tropical depressions move up the Colorado River Valley. Tropical storms Kathleen, on September 10-11, 1976 (Figures 3 through 6), and Doreen, on August 16, 1977 (Figures 7 through 10), caused millions of dollars worth of property damage.

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Figure 2. Aerial View, Bullhead City, Arizona

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Figure 3. Chaparral Washington area just west of State Highway 95. Photograph courtesy of Mohave Valley News.

Figure 4. Chaparral Wash, once an 8-foot ditch, now 25-foot-high walls. Photograph courtesy of Mohave Valley News.

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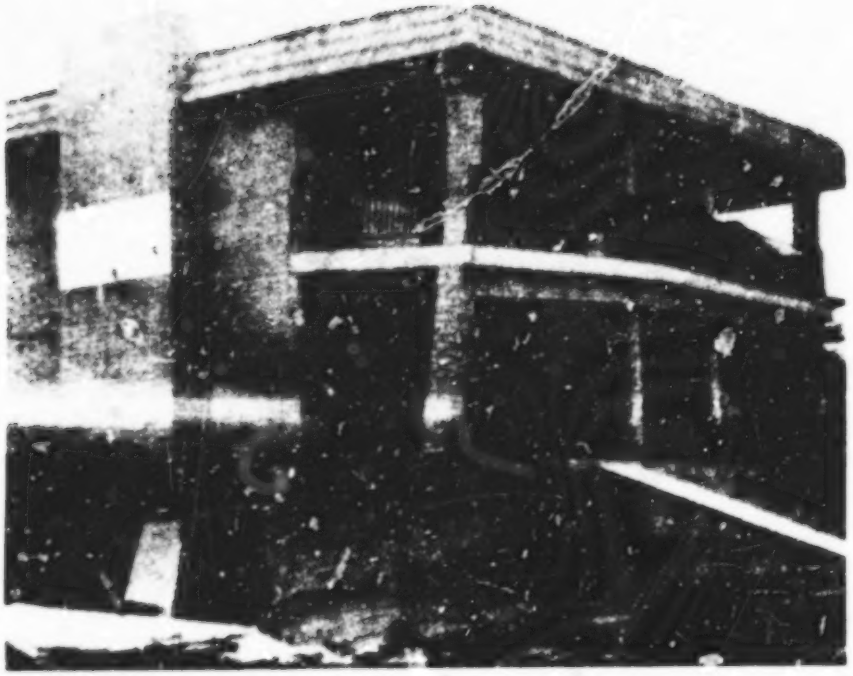

Figure 5. Structural damage from undermining floodwaters near Montana Wash at Colorado River. Photograph courtesy of Mohave Valley News.

Figure 6. Alluvium deposit near Montana Wash. Photograph courtesy of Mohave Valley News.

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Figure 7. Remains of Seventh Street in Bullhead City looking west. Photograph courtesy of Mohave Valley News.

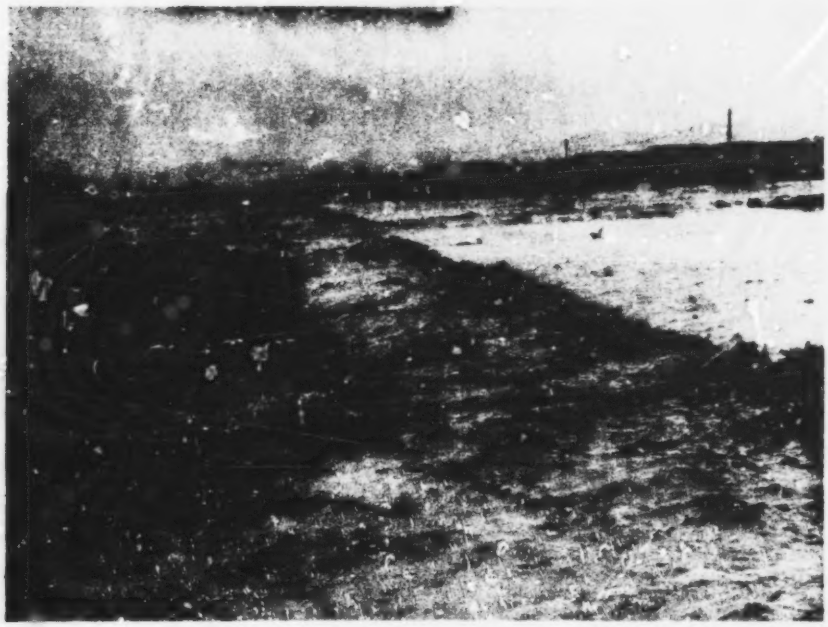

Figure 8. Floodwaters recede near Secret Pass Wash crossing over State Highway 95. Photograph courtesy of Mohave Valley News.

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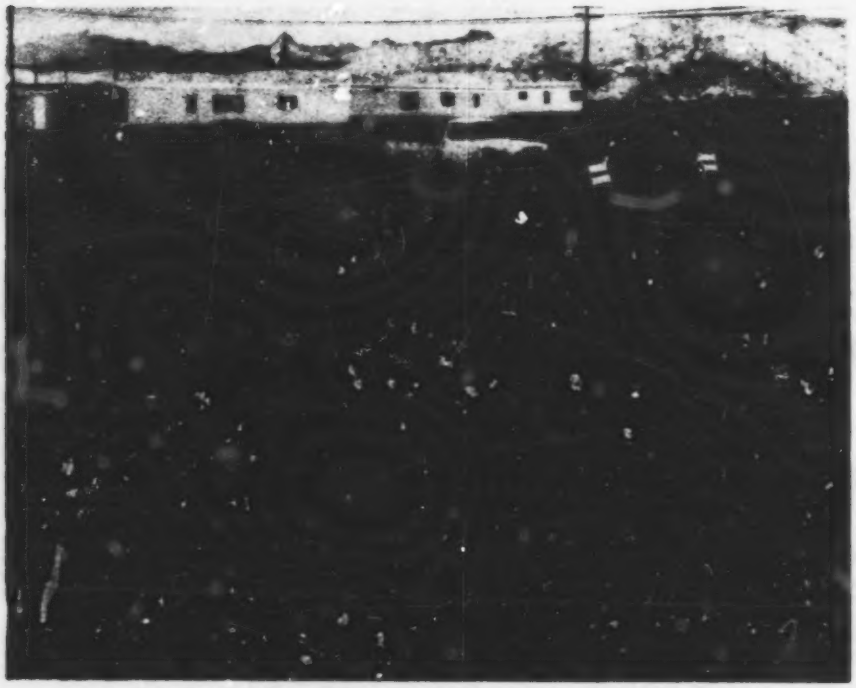

Figure 9. Silver Creek Wash securing damage at State Highway 95. Photograph courtesy of Mohave Valley News.

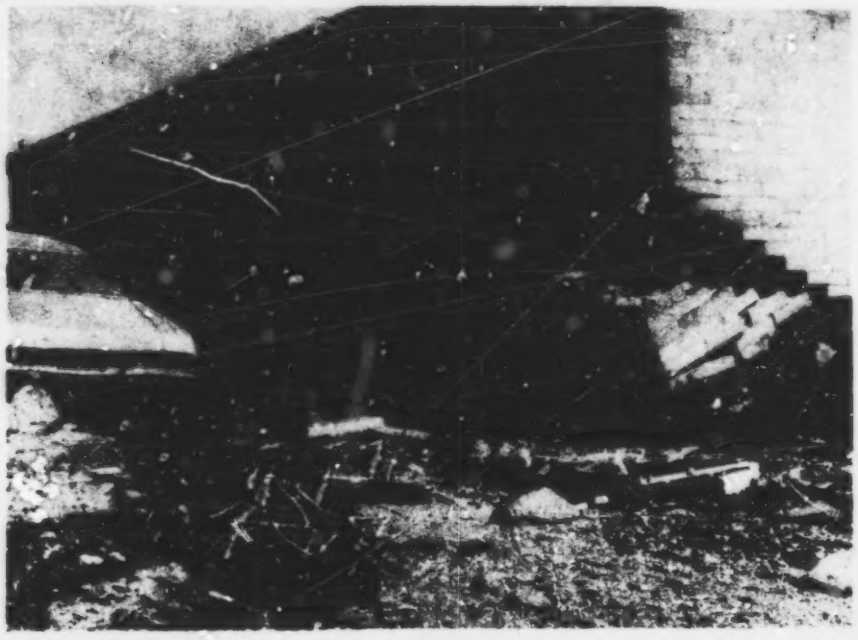

Figure 10. Floodwaters undermine and devastate foundations in Black Wash. Photograph courtesy of Mohave Valley News.

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The Colorado River has been a major flooding source in the Mohave Valley. This valley is of alluvial origin and prior to the construction of levees for channelization, the river twisted and meandered through the area. Prior to the construction of Hoover and other dams on the Colorado River, major snowmelt floods caused damage to the lower Colorado River basin each spring. Peak flood flows of 300,000 cubic feet per second (cfs) occurred in 1884, and 220,000 cfs occurred in 1921 (Reference 4). These flows are far in excess of the present 500-year frequency flood used in this study.

During the spring and early summer of 1984, higher than normal snowmelt in the Colorado River Basin filled the storage capacity of the Colorado River dam system. Releases in excess of 40,000 cfs from Davis Dam were required for a period of time during the late summer and fall of 1984. Several residential structures adjacent to the Colorado River experienced flood damage as a result of these releases.

2.4 Flood Protection Measures

Flood discharges on the Colorado River are greatly mitigated by the system of dams upstream of the City of Bullhead City. Additionally, the USBR has constructed a levee for flood protection along the Colorado River through Bullhead City. The levee, designed to contain the 100-year discharge, is armored with rock riprap to protect it from erosion.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1 and 0.2 percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

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3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish peak discharge-frequency relationships for each flooding source studied in detail affecting the community.

Discharges for the flooding sources studied in detail were developed using a U.S. Soil Conservation Service (SCS) computer program (Reference 5). This SCS methodology uses basin physical characteristics, soil classification, cover conditions, and precipitation amounts as parameters for developing runoff.

Each basin was divided into subwatersheds with attention given to homogeneity, soil type, and cover conditions. Times of concentration were computed using Manning's equation to develop the velocity component. Drainage areas were measured using U.S. Geological Survey (USGS) topographic maps (Reference 6).

Soil classification and cover conditions were determined from field surveys (Reference 7) and an unpublished soil survey for parts of Mohave County obtained through the SCS, Kingman Field Office. Antecedent moisture condition 2 was used for the soil moisture content.

A National Oceanic and Atmospheric Administration precipitation-frequency atlas (Reference 8) was used to select rainfall amounts for the 10-, 50-, and 100-year events. The 500-year rainfall amount was derived on extreme probability paper from extrapolation of a line through the plotted 10-, 50-, and 100-year values.

All flooding sources were analyzed to determine the peak discharge for the 1- and 24-hour rainfall distributions. Peak discharge-drainage area relationships for the flooding sources studied in detail are shown in Table 1.

TABLE 1. SUMMARY OF DISCHARGES

Flooding Source and Location	Drainage Area (square miles)	Peak Discharges (cubic feet per second) 10-Year	50-Year	100-Year	500-Year
Colorado River					
At Bullhead City	169,300	28,000	40,000	50,000	73,000
Davis Wash					
At Upstream Limit of Detailed Study	1.3	545	1,050	1,310	1,900
At State Highway 95	1.7	595	1,190	1,500	2,320
Highland Wash					
At Confluence With Green and Williams Washes	5.0	1,020	2,625	3,285	5,540
At State Highway 95	5.4	1,025	2,660	3,330	5,655

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TABLE 1. SUMMARY OF DISCHARGES (cont.)

Flooding Source and Location	Drainage Area (square miles)	Peak Discharges (cubic feet per second) 10-Year	50-Year	100-Year	500-Year
Williams Wash					
At Upstream Limit of Detailed Study	1.4	470	1,135	1,400	2,135
At Confluence With Highland Wash	2.8	605	1,555	1,930	3,225
Green Wash					
At Upstream Limit of Detailed Study	0.8	265	600	750	1,140
At Confluence With Highland Wash	2.2	440	1,155	1,460	2,410
Thumb Butte Wash					
At Upstream Limit of Detailed Study	2.0	550	1,245	1,565	2,350
At State Highway 95	7.3	1,685	4,100	5,020	8,085
Buck Wash					
At Upstream Limit of Detailed Study	0.5	155	330	420	625
At State Highway 95[1]	1.0	380	907	1,145	1,875
Black Wash					
At Upstream Limit of Detailed Study	14.4	3,265	8,250	10,200	16,035
At State Highway 95	15.0	2,570	6,670	8,205	13,760
Bullhead Wash					
At Upstream Limit of Detailed Study	1.2	420	1,010	1,285	1,975
At State Highway 95	1.5	920	2,315	2,980	4,700
Secret Pass Wash					
At Upstream Limit of Detailed Study	20.3	4,345	9,860	12,085	18,105
At State Highway 95	21.1	4,280	9,750	11,955	18,325
Dump Wash					
At Upstream Limit of Detailed Study	2.4	520	1,365	1,745	2,910
At State Highway 95	3.0	610	1,610	2,060	3,450
Silver Creek Wash					
At Upstream Limit of Detailed Study	28.8	5,420	11,975	14,715	22,715
At State Highway 95	35.7	5,725	12,655	15,565	24,050

[1] 20 percent of discharge diverted to Bullhead Wash

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TABLE 1. SUMMARY OF DISCHARGES (cont.)

Flooding Source and Location	Drainage Area (square miles)	Peak Discharges (cubic feet per second) 10-Year	50-Year	100-Year	500-Year
Montana Wash					
At Upstream Limit of Detailed Study	2.4	525	1,355	1,725	2,765
At State Highway 95	4.3	685	1,900	2,435	4,220
At Confluence With Colorado River	6.0	1,035	2,775	3,540	5,970
Big Montana Wash					
At Upstream Limit of Detailed Study	0.7	285	545	690	990
At State Highway 95	1.3	370	845	1,065	1,620
At Confluence with Montana Wash	1.7	405	910	1,155	1,805
Chaparral Wash					
At State Highway 95	1.9	475	1,060	1,320	2,000
Bojorquez Wash					
At Lause Road	5.4	825	2,235	2,920	4,795
At Lakeside Drive	11.1	1,470	4,580	5,870	9,805
Fox Wash					
At Upstream Limit of Detailed Study	3.2	595	1,545	1,960	3,170
Soto Wash					
At Upstream Limit of Detailed Study	2.2	540	1,420	1,780	2,725
At State Highway 95	2.7	550	1,460	1,840	2,940
Fort Mohave Wash					
At Upstream Limit of Detailed Study	4.7	985	2,540	3,190	4,975

Discharges on Secret Pass Wash decrease toward the downstream end of the study area because of absorption by the ground alluvium, the narrowing of the drainage basin near State Highway 95, and the lack of tributary drainage.

Peak discharge-frequency relationships for the Colorado River were based on operating procedures for Hoover Dam (Reference 9) and USBR information (Reference 4). These discharges were adopted for the Bullhead City study area. The 100-year peak dishcarge is equivalent to the "levee design flood" used by the USBR. The 10-, 50-, and 500-year peak discharge relationships were based on operating procedures for Hoover Dam and additional information provided by the USBR (References 4 and 9).

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3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

For the Bullhead City area, statistical analyses were used to compute flood depths and velocities for the areas subject to alluvial fan flooding. In accordance with FEMA guidelines, the alluvial fan is characterized by unstable channel systems due to slope and soil conditions. Consequently, flows rarely spread evenly over the surface of an alluvial fan and can be concentrated in an identifiable, temporary channel or confined to only portions of the fan surface. The ability to scour and deposit sediment makes flow paths prone to lateral migration and relocation to any portion of the fan during a single runoff event and subsequent events. This erratic, unpredictable behavior subjects all portions of the fan to potential flood hazard, regardless of location. As the fan widens, the probability of flooding at a given depth and velocity at a specific point generally decreases.

Bojorquez Wash causes ponding in the low-lying area of Chaparral Golf Course in North Mohave Valley. Runoff flows to the north and is discharged through a storm drainage channel into the Colorado River. A reservoir flood-routing method was used to model the area and determine the base flood elevation.

Normal-depth calculations supplemented the alluvial fan methodology on the upstream reaches of Highland, Williams, and Big Montana Washes.

Cross sections for the backwater analyses of Colorado River were obtained from the USBR (Reference 4). The below-water sections were obtained by field measurement. Ground topography was joined with the river cross section information at appropriate locations using aerial photogrammetry, flown in 1984 and compiled at a map scale of 1" = 400' with a 4-foot contour interval (Reference 10).

Detailed analyses of the hydraulic characteristics of flooding for the Colorado River were performed to provide estimates of the water-surface elevations for the 10-, 50-, 100-, and 500-year recurrence interval events.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross section locations are also shown on the Flood Insurance Rate Map (Exhibit 2).

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Roughness coefficients (Manning's "n") used in the hydraulic analysis were selected based on review of previously used values, field observation, and engineering judgement (Reference 9). For the Colorado River, a roughness value of 0.030 was used for the main channel, and a value of 0.125 for the overbank areas.

Water-surface elevations for the selected recurrence intervals were computed using the U.S. Army Corps of Engineers' HEC-2 water-surface profiles computer model (Reference 11). Starting water-surface elevations were determined by constructing stage/discharge curves from information supplied by the USBR and the USGS.

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in this study are shown on the maps; the description of the marks are presented in Elevation Reference Marks (Exhibit 3).

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages state and local governments to adopt sound floodplain management programs. Therefore, each Flood Insurance Study provides 100-year flood elevations and delineations of the 100- and 500-year floodplain boundaries and 100-year floodway to assist communities in developing floodplain management measures.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2 percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the 100- and 500-year floodplain boundaries have been delineated using the flood elevations determined at each cross section.

Between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:24,000, with a contour interval of 40 feet, reduced to a scale of 1:4,800 (Reference 6). For the Colorado River, flood boundaries were interpolated using topographic maps at scale of 1:4,800 with a contour interval of 4 feet (Reference 10).

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The 100- and 500-year floodplain boundaries are shown on the Flood Insurance Rate Map (Exhibit 2). On this map, the 100-year floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A, AE, AH, and AO); and the 500-year floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 100- and 500-year floodplain boundaries are close together, only the 100-year floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

For the streams studied by approximate methods, only the 100-year floodplain boundary is shown on the Flood Insurance Rate Map (Exhibit 2.)

Approximate 100-year floodplain boundaries in some portions of the study area were taken directly from the Flood Hazard Boundary Map (Reference 12) and verified using the topographic maps (Reference 6) reduced to a scale of 1:4,800 in conjunction with previously estimated elevations.

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the NFIP, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 100-year floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum Federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodways presented in this study were set at the location of the existing levee system. A 1.0 foot surcharge was assumed at the downstream limit of detailed study. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations are tabulated at selected cross sections (Table 2). In cases where the floodway and 100-year floodplain boundaries are either close together or collinear, only the floodway boundary has been shown.

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH[2] (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE[3]
					(FEET NGVD)			
Colorado River								
A	262.3	945/290	10,764	4.6	491.3	491.3	492.3	1.0
B	263.0	971/300	11,259	4.4	492.1	492.1	493.0	0.9
C	263.4	962/280	9,308	5.4	492.6	492.6	493.4	0.8
D	264.4	459/260	7,618	6.6	494.6	494.6	495.2	0.6
E	265.4	681/400	9,562	5.2	496.9	496.9	497.3	0.4
F	266.5	663/300	8,853	5.6	499.3	499.3	499.5	0.2
G	267.3	639/400	8,098	6.2	500.9	500.9	501.3	0.4
H	268.0	569/250	9,555	5.2	502.0	502.0	503.0	1.0
I	269.0	552/280	9,509	5.3	503.3	503.3	504.2	0.9
J	269.8	1001/630	11,444	4.4	504.8	504.8	505.5	0.7
K	270.5	561/300	7,773	6.4	505.8	505.8	506.4	0.6
L	271.2	563/350	10,276	4.9	507.4	507.4	507.8	0.4
M	271.9	763/370	15,626	3.2	508.1	508.1	508.5	0.4
N	273.0	746/390	11,052	4.5	508.7	508.7	509.1	0.4

[1] Stream Distance in Miles above Mexican Boundary
[2] Width/Width within Corporate Limits

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TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF BULLHEAD CITY, AZ
(MOHAVE CO.)

FLOODWAY DATA

COLORADO RIVER

The area between the floodway and 100-year floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 11.

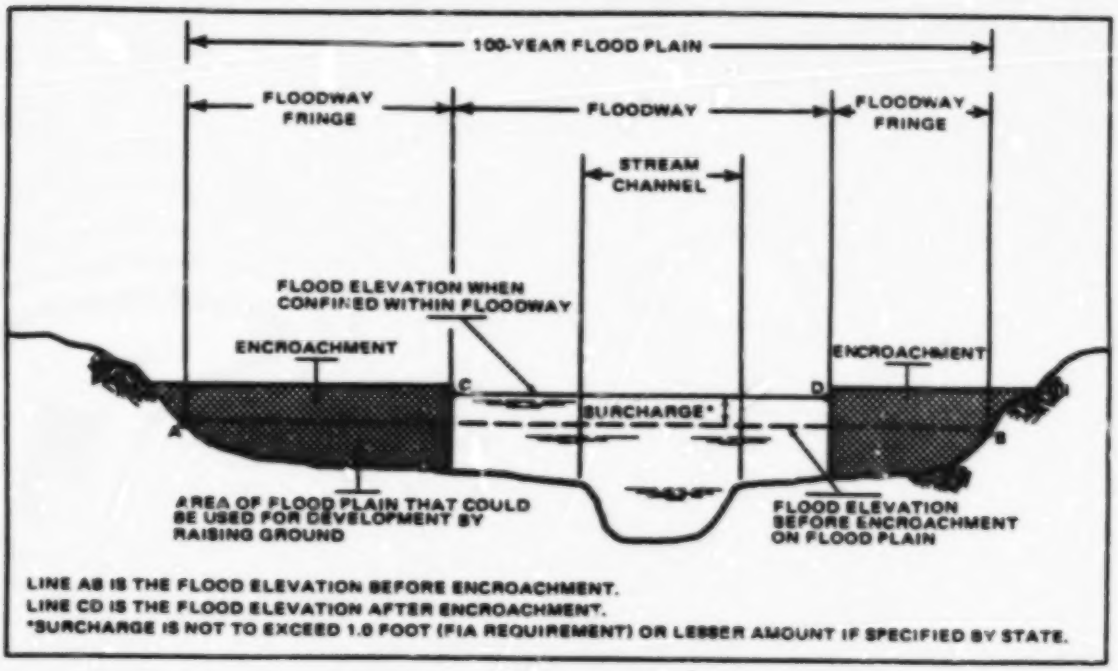
100-YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE AB IS THE FLOOD ELEVATION BEFORE ENCROACHMENT.
LINE CD IS THE FLOOD ELEVATION AFTER ENCROACHMENT.
*SURCHARGE IS NOT TO EXCEED 1.0 FOOT (FIA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE.

Figure 11. Floodway Schematic

5.0 INSURANCE APPLICATION

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. These zones are as follows:

Zone A

Zone A is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base flood elevations or depths are shown within this zone.

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Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by detailed methods. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AH

Zone AH is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AO

Zone AO is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-foot depths derived from the detailed hydraulic analyses are shown within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 500-year floodplain, areas within the 500-year floodplain, areas of 100-year flooding where average depths are less than 1 foot, areas of 100-year flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 100-year flood by levees. No base flood elevations or depths are shown within this zone.

Alluvial fan flood hazard areas are shown on the Flood Insurance Rate Map as Zone AO, with average depths and velocities of flow given. In these areas, the 100-year flood depths may exceed 3 feet. Development on alluvial fans is subject to a more severe flood hazard than would normally be encountered in Zone AO because of high velocities and the unpredictability of the location of the stream channel across the width of the fan.

6.0 FLOOD INSURANCE RATE MAP

The Flood Insurance Rate Map is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the 100-year floodplains that were studied by detailed methods, shows selected whole-foot base

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flood elevations or average depths. Insurance agents use the zones and base flood elevations in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols, the 100- and 500-year floodplains, floodways, and the locations of selected cross sections used in the hydraulic analyses and floodway computations.

7.0 OTHER STUDIES

Because this study has been prepared using the Flood Insurance Study for Mohave County, Arizona (Reference 1), the results of this study match exactly the results of the Mohave County study.

FEMA is currently revising the Flood Insurance Study for the unincorporated areas of Clark County, Nevada (Reference 13). The results of this study will match exactly the results of the Clark County study.

The USBR is currently performing a state of the art hydrologic analysis to determine peak discharges for the Colorado River including all of its tributaries and analyzing the effect of the system of dams. The results of this study will be available in 1987 according to USBR officials.

8.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, FEMA, Presidio of San Francisco, Building 105, San Francisco, California 94129.

9.0 BIBLIOGRAPHY AND REFERENCES

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EXHIBIT 3 - ELEVATION REFERENCE MARKS
CITY OF BULLHEAD CITY, MOHAVE COUNTY, ARIZONA

Reference Mark	Elevation (feet NGVD)	Description of Location
RM 1	553.03	A 3-inch brass cap stamped "4SBR 553", 4,050 feet west and 100 feet north of southeast corner of Section 31, T21N, R21W, near southeast corner of Bullhead City post office. Established by U.S. Geological Survey.
RM 2	539.74	U.S. Geological Survey 3-inch brass cap, stamped "3 EAM 1965", 1,850 feet west and 900 feet north of southeast corner of Section 1, T20N, R22W, 30 feet west of State Highway 95 centerline and 300 feet north of 2nd Street centerline.
RM 3	535.67	U.S. Geological Survey 3-inch brass cap, stamped "4 EAM 1965", 3,000 feet west and 1,500 feet north of southeast corner of Section 12, T20N, R22W, 50 feet southeast of intersection of State Highway 95 and Secret Pass Road.
RM 4	535.12	Arizona Department of Transportation brass cap in upstream concrete box culvert headwall of Silver Creek Wash and State Highway 95, 700 feet north and 800 feet west of southeast corner of Section 9, T20N, R22W.
RM 5	790.24	A 3-inch brass cap set in large boulder, stamped "6 EAM 1965", 0.9 mile east of State Highway 95, 1850 feet east of southwest corner of Section 13, T20N, R22W.
RM 6	510.87	Chiseled "X" in top head bolt on east side of fire hydrant on southwest corner of River Front Drive and Colorado-Rio Vista, 1,250 feet west and 4,400 feet north of southeast corner of Section 17, T20N, R22W. Established by Mohave County Engineer.
RM 7	656.6	U.S. General Land Office pipe and cap stamped "T20N R22W S17 S16 1915", located 890 feet east of intersection of State Highway 95 and Hancock Road at the southwest corner of Section 16, T20N, R22W.
RM 8	689.0	Set 1/2" rebar south of south end of Mesa Vista Drive and 600 feet south of water tanks atop small mesa.

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EXHIBIT 3 - ELEVATION REFERENCE MARKS (cont.)
CITY OF BULLHEAD CITY, MOHAVE COUNTY, ARIZONA

Reference Mark	Elevation (feet NGVD)	Description of Location
RM 9	534.2	Set cotton spindle at centerline of intersection of Baseline Road, Ramar Road, and Trane Road.
RM 10	521.8	Set cotton spindle in centerline of Plata Drive, 250 feet west of State Highway 95 on south side of shopping center east side of river.
RM 11	540.1	Set 1/2" rebar, 150 feet east of State Highway 95 and 1/2 mile south of First Street in Bullhead City.
RM 12	530.8	Set cotton spindle at centerline of intersection of Third Street and Moser Avenue in Bullhead City.
RM 13	603.0	Set 1/2" rebar on centerline of dike at intersection with Section line east of South quarter corner of Section 31, T21N, R21W.
RM 14	549.5	Set cotton spindle at intersection of centerline of Surf and Sand Drive and Surf Cove Street.
RM 15	514.3	Set cotton spindle at centerline of intersection of Lakeside Drive and Riverview Drive.
RM 16	520.9	Set 1/2" rebar in center of empty lot on west side of Taylor Road and at the intersection of Taylor Road and Terrace Drive.
RM 17	524.1	Found rebar at centerline of Hancock Road, 15 feet east of the centerline of Taylor Road.
RM 18	508.2	Set cotton spindle at centerline of west bound lane of Rivera Drive, 130 feet west of centerline of Riverview Drive.
RM 19	556.8	Set cotton spindle in centerline of Mohave Drive, 75 feet east of State Highway 95.
RM 20	765.1	Set 1/2" rebar atop Hogback near the Southwest 1/16 Corner Section 26, T20N, R22W.
RM 21	509.0	Set 1/2" rebar, 100' west of State Highway 95 and 250' south of Entrance Road to Mohave Community College.

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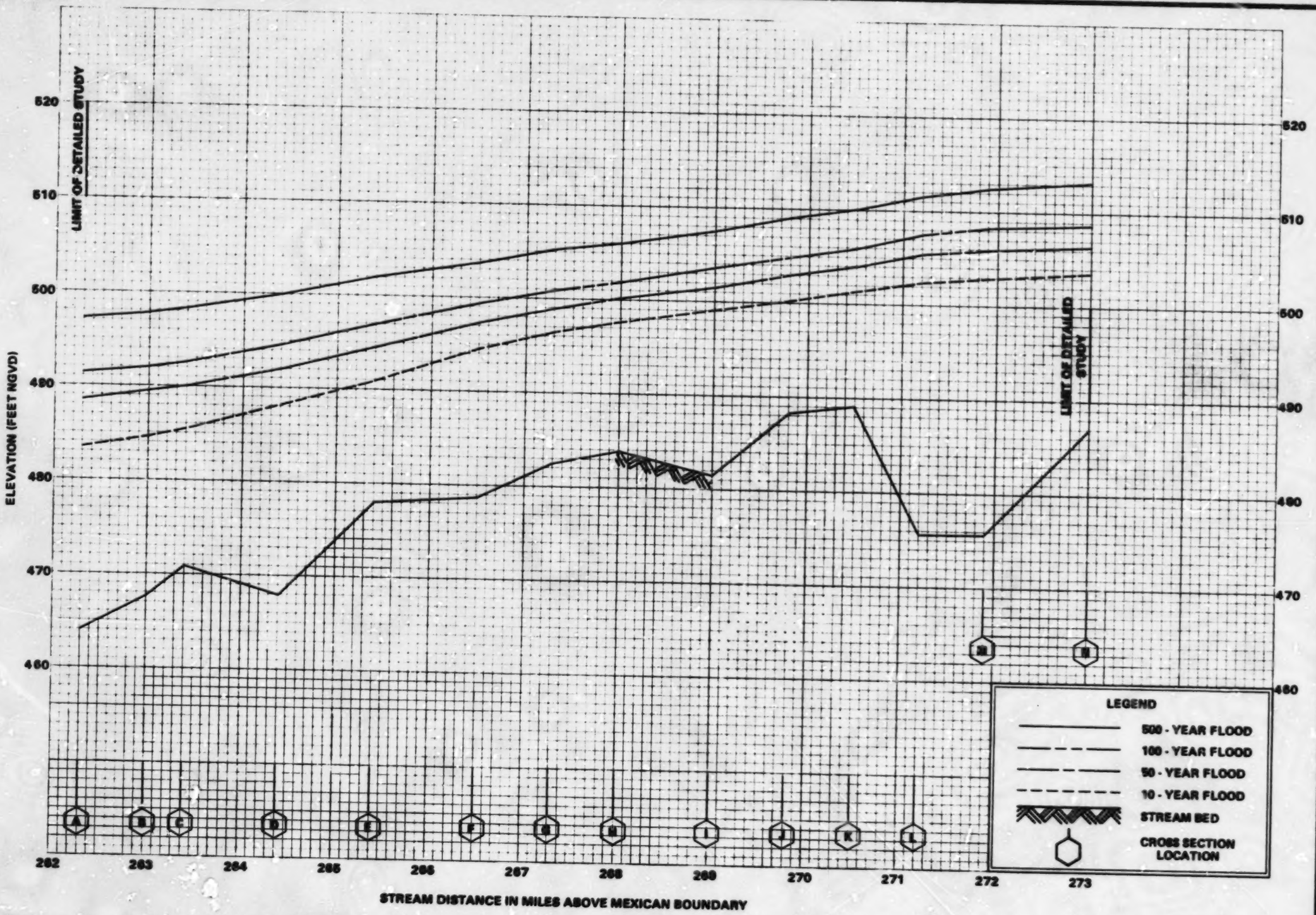

FLOOD PROFILES

COLORADO RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF BULLHEAD CITY, AZ
(MOHAVE CO.)

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